Leveraging GIS Tools in Defense and Response at the U.S. Air Force Academy

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Abstract

The mission of the United States Air Force Academy is to "inspire and develop outstanding young men and women to become Air Force officers with knowledge, character and discipline; motivated to lead the world's greatest aerospace-force in service to the nation." As both a university and a military academy, the faculty faces a unique challenge to not only develop cadets educationally, but prepare all of its graduates to be successful leaders in the nation's Air Force. The primary method the Academy uses for ensuring its graduates are prepared to overcome the challenges they will face as officers is embodied in the core curriculum. In the Air Force Academy's core curriculum, all 4400 cadets are required to take a minimum of 132 credit hours of courses in the humanities, math, science and engineering fields. One of these courses is Civil Engineering 210, "Air Base Design and Performance." Looking deeper, this class is divided into three blocks: 1) Environmental 2) Infrastructure and 3) Contingency Response. In both the second and third blocks, cadets participate in capstone projects that employ concepts they learned in the classroom including community planning, functional relationship analysis, Air Installation Compatibility Use Zones (AICUZ), contingency operations, bare base beddown, Air Base Ground Defense (ABGD), Base Damage Assessment Teams (BDAT), Minimum Operating Strip (MOS) planning, Alternate Launch and Recovery Surface (ALRS) planning, and Base Recovery After Attack (BRAAT) just to name a few. This paper will discuss the operational Air Force Geographical Information System (GIS) software interfaces that have been tailored to use in conveying the classroom objectives to educate and train cadets in Civil Engineering 210 to ensure Air Force Academy graduates are officers with the knowledge to "lead the world's greatest aerospace-force in service to the nation."

Introduction

The mission of the United States Air Force Academy is to "inspire and develop outstanding young men and women to become Air Force officers with knowledge, character and discipline; motivated to lead the world's greatest aerospace-force in service to the nation." As both a university and a military academy, the faculty faces a unique challenge to not only develop cadets educationally, but prepare all of its graduates to be successful leaders in the nation's Air Force. The primary method the Academy uses for ensuring its graduates are prepared to overcome the challenges they will face as officers is embodied in the core curriculum. In the Air Force Academy's core curriculum, all 4400 cadets are required to take a minimum of 132 credit hours of courses in the humanities, math, science and engineering fields. One of these courses is Civil Engineering 210, "Air Base Design and Performance." Looking deeper, this class is divided into three blocks: 1) Environmental 2) Infrastructure and 3) Contingency Response. In both the second and third blocks, cadets participate in capstone projects that employ concepts they learned in the classroom including community planning, functional relationship analysis, Air Installation Compatibility Use Zones (AICUZ), contingency operations, bare base beddown, Air Base Ground Defense (ABGD), Base Damage Assessment Teams (BDAT), Minimum Operating Strip (MOS) planning, Alternate Launch and Recovery Surface (ALRS) planning, and Base Recovery After Attack (BRAAT) just to name a few. This paper will discuss the operational Air Force Geographical Information System (GIS) software interfaces that have been tailored to use in conveying the classroom objectives to educate and train cadets in Civil Engineering 210 to ensure Air Force Academy graduates are officers with the knowledge to "lead the world's greatest aerospace-force in service to the nation."

Literature Review

One of the primary focus areas of the U.S. Air Force Academy's Superintendent, Lieutenant General John W. Rosa, is to align and orient the Academy on the operational Air Force whenever possible. Therefore, when planning the computer interfaces that the cadets would use in Civ Engr 210, the faculty knew it was important to ensure that they focused on aligning their efforts with the Air Force's GeoBase program. GeoBase is the name given to all organized GIS initiatives within the service. Each installation or Air Force Base has its own GeoIntegration Office where it is the GeoIntegration Officer's (GIO) responsibility to ensure that he focuses on tying all geospatial information (anything that can be better described with a location) to the base Common Installation Picture (CIP) or base map.

[1]Installations are the combat support backbone for the Air Force mission. Just as the battlespace relies on information superiority and agile combat support, installation operations also require disciplined creation, management and sharing of critical georeferenced information through modern mapping processes. The USAF GeoBase fills this critical need across the mission spectrum.

Figure 1. Air Force GeoBase Logo

The umbrella term GeoBase is a response to compelling evidence of widespread fiscal waste and decision inferiority attributable to mapping processes being decentralized across Air Force installations. Just as warfighters realized they cannot succeed without a common operational picture of the "battlespace", commanders, planners, and personnel across the combat support spectrum similarly need access to a common installation picture of "basingspace" for mission success.

The GeoBase vision is "One Installation…One Map" with a mission to "attain, maintain and sustain one geospatial infostructure supporting all installation requirements". This geospatial infostructure includes the people, processes, and resources used in the collection, analysis, and display of georeferenced data to support the installation mission. The GeoBase service is made available via the existing base communications network using GIS and similar technologies. Existing mission systems and processes are enhanced by visualizing their assets and information via an installation map or CIP.

Balanced attention to both technology and sustainment processes are prerequisites for GeoBase success. The GeoBase agenda aims to infuse new geospatial information management practices and principles throughout the Air Force basing missions. Accomplishing this task will require a much broader, comprehensive implementation strategy than that typically associated with a new Information Technology (IT) acquisition program.

The installation mission is comprised of four unique decision support environments. Garrison GeoBase replaces the many overlapping mapping efforts across our major and minor installations with a single, coherent approach to geospatial information stewardship. The GeoReach process provides senior planners and airmen alike with new intelligence enabling improved forward operating location (FOL) selection, time-phased force deployment data (TPFDD) planning, and accelerated bed-down. Expeditionary GeoBase is a lean, deployed version of the Garrison GeoBase, affording provisional commanders and airmen new situational awareness of the expeditionary base. Strategic GeoBase offers senior staff across the Major Commands, Air Staff, and the Secretariat new means to visualize the broader installation and range situation through generalized views of Garrison GeoBase imagery and data.

Discussion

The Department of Civil and Environmental Engineering (DFCE) is excited to build on the foundation that Air Force GeoBase planers have laid for the successful integration of new information management technology through GIS across, the Air Force, feels that they have credence when they say that they implemented the most aggressive implementation of GIS in all of academia with their initiatives in the fall of 2004. DFCE sees their core class, Civ Engr 210, as an opportunity to inculcate the capabilities thatGeoBase and GIS applications provide into thousands of fut ure leaders in our nation's Air Force.

Specifically, Civ Engr 210 implemented two new applications that mirror how GeoBase is implemented in the operational Air Force. They are called *Build-a-Base* and the *Contingency Support Exercise* (CSE). Civ Engr 210 is a three block course covering the environment, infrastructure, and contingency operations associated with an Air Force base. This serves as both an introduction to traditional civil engineering and Air Force operations from a support perspective. Since the Academy's primary focus is to orient and align itself on the operational Air Force, Civ Engr 210 is the perfect location for training tomorrow's leaders on the decision making capabilities that GIS applications will provide them in the future.

Build-a-Base: In the second of the three major blocks of instruction, Build-a-Base serves as the culminating project testing cadets' mastery of base comprehensive planning, functional land use analysis, and the Air Installation Compatibility Use Zone (AICUZ) concept. Cadets are given four 50-minute sessions to create an

Figure 2. A Typical View of a Build-a-Base Map Before Work Begins

operational Air Force base on a literal blank slate. For all 23 sections of the 24-person class, twelve teams of two people each are given the real world Installation Visualization Tool (IVT) imagery for one of six possible CONUS installations with a white mask over everything inside the installation perimeter.

Using only a list of required facilities and the constraints provided by the surrounding community, cadets plan the layout and flow of an Air Force base. Cadets see the importance of placing industrial functions near airfield operations, while at the same time keeping them away from housing, schools, and hospitals.

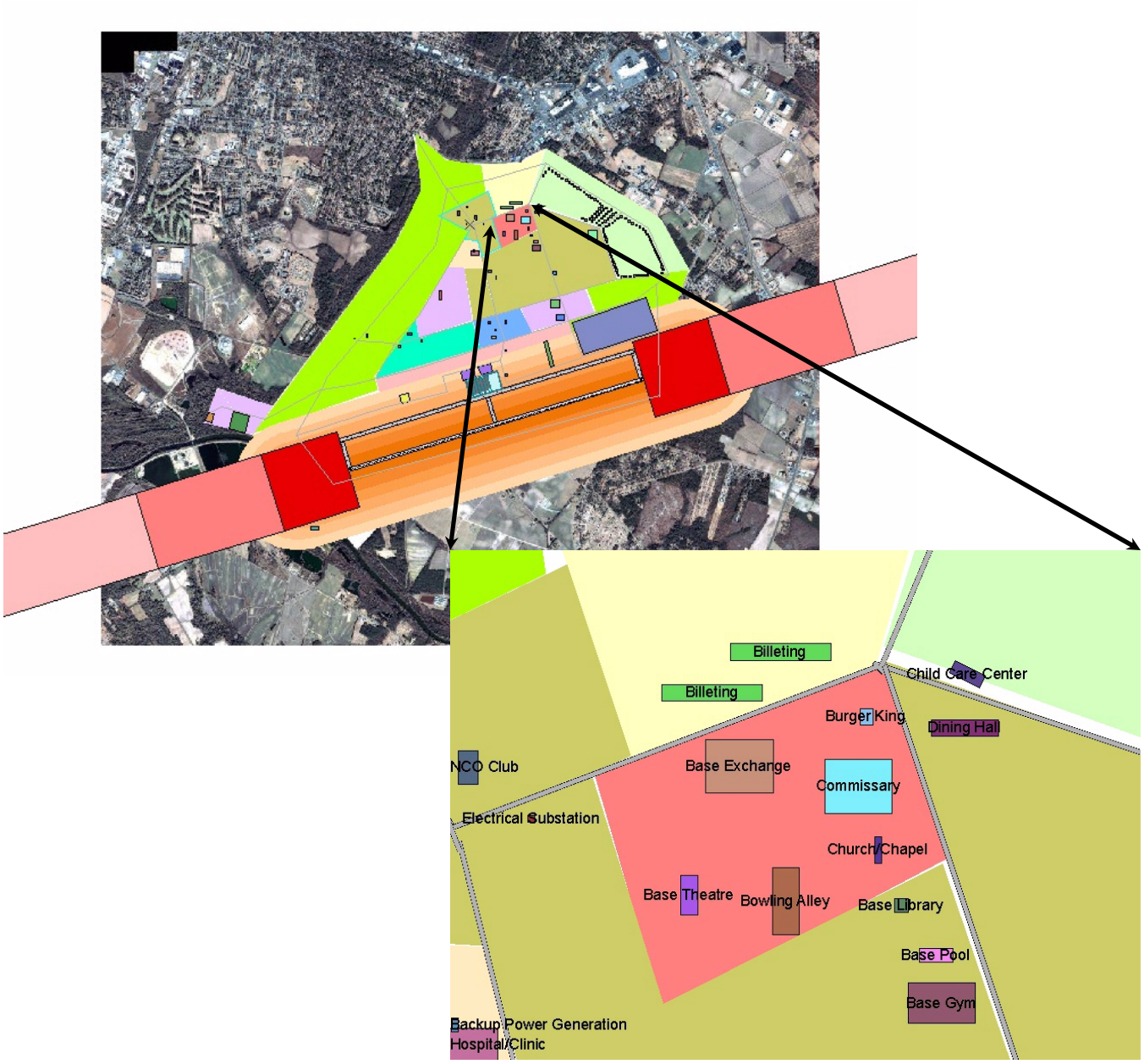


Figure 3. A Typical View of a Completed Build-a-Base Map with a Zoom-In View of the Community Center Functions

The Contingency Support Exercise (CSE): While Build-a-Base is a new addition to the core course, the CSE replaces what became an antiquated CAD-based product and scenario called CRISIS. Seeing the opportunity to upgrade our technological platform while also replacing the outdated Iraqi-based scenario, the

Figure 4. View of Former CAD-based Map

team of Major Don Ohlemacher, Army Captain Tom "BULL" Holland, and Captain Patrick Suermann teamed with local computer specialists, Unique Solutions' Don Sanborn and Tim "TJ" Johnson to create a world class product based on a Korean scenario with a real Common Installation Picture (CIP) from the peninsula, which is named K-93 for the sake of the exercise.

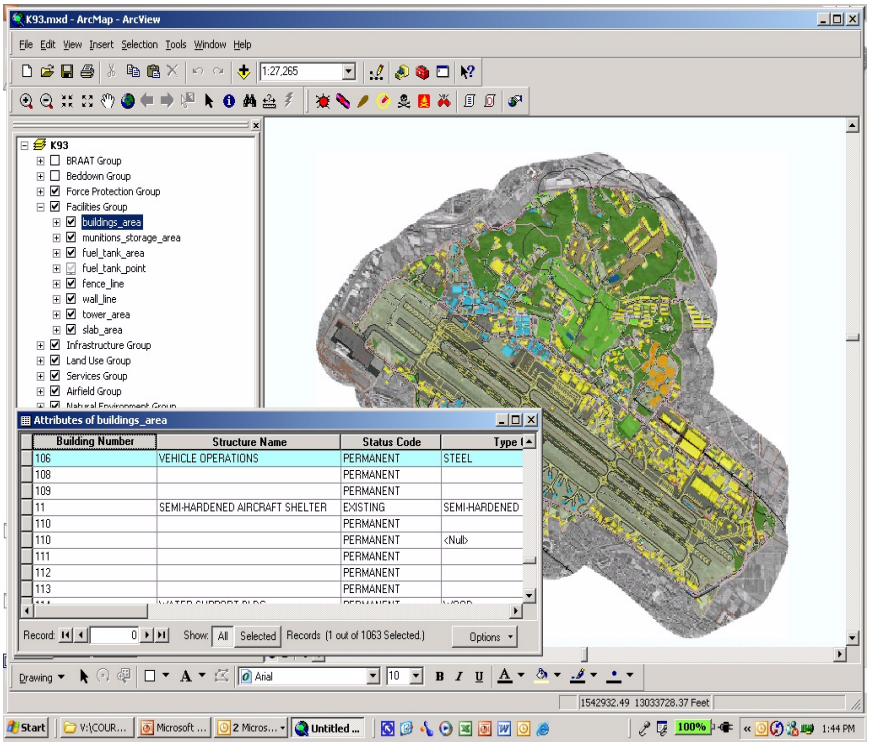


Figure 5. View of K-93 Interface

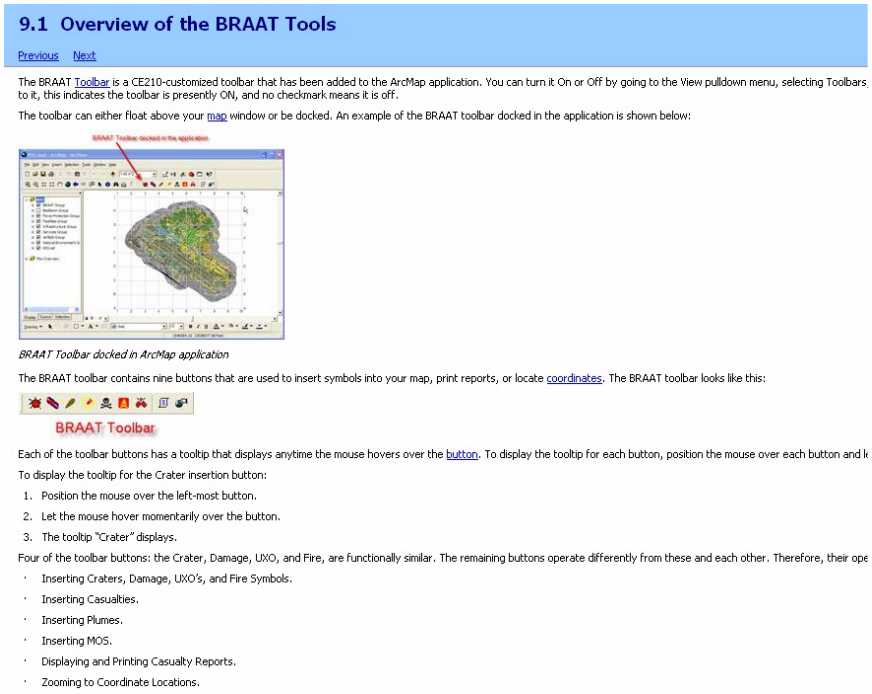
Cadets play the role of the 335th Tactical Fighter Wing based at Seymour Johnson Air Force Base in North Carolina. When a North Korean coup occurs in the Democratic People's Republic of Korea's (DPRK) communist government; cadets are responsible for planning a successful deployment and beddown of forces at a forward co-located operating base. Through the course of the scenario, cadets identify their requirements, deploy an Advance reconnaissance (ADVON) team, conduct a surge assessment, identify/overcome shortfalls, deploy a beddown team and follow-on forces to sustain simulated 24-hour operations throughout seven 50-minute in-class work sessions.

Additionally, cadets develop a tent city beddown with the help of the Titan-created Air Force GeoBEST tool. Cadets are given inputs received through an Outlook messaging system giving them intelligence, adding to the fog and friction of war, and also testing their expertise in GIS functions like queries, facility identification, and buffers through "time sensitive questions." Performing well on these time sensitive questions can lessen the damage cadets receive on Day 6, "Attack Day." Those performing poorly receive the most damage in the form of airfield craters, structure fires, Unexploded Ordnances (UXOs), toxic plumes, and casualties totaling over 80 inputs that the cadets must plot successfully in approximately 40 minutes.

Figure 6. Prototypical View of Cadets Operating on K-93

The Geo210 Tutorial: DFCE feels that they have revolutionized the philosophy of GIS training by developing a real world GIS education package. Rather than walk cadets through every step necessary to accomplish all the tasks in the "exercise days" in-class, cadets download a ten chapter "Geo210" tutorial that spells out "must-do" tasks they need in both Build-a-Base and the CSE. Cadets

practice the needed skills on the Air Force Academy's CIP, and then execute the tasks on either their Build-a-Base or K-93 CIP. Not only do the cadets first get to practice with a base on which they are familiar; they also get the benefit of seeing the universality of the software and the learning benefit of task repetition. As a learning tool, the tutorial is fantastic because the cadets can learn ArcMap commands and icons at their own pace without the "slowest common denominator" setting the pace of the course. Cadets know what they need to do and how to do it before they are expected to accomplish the desired objective in class. On the more advanced tasks, such as joining an excel spreadsheet into the buildings' attribute table during the beddown phase of the CSE; the tutorial even has "movies" (.avi files) that demonstrate the steps for successful completion of joining the data. The movie can be played, paused, and replayed as often as each cadet needs in order to be successful with their task.



9.1 Overview of the BRAAT Tools

Previous Next

The BRAAT Toolbar is a CE210-customized toolbar that has been added to the ArcMap application. You can turn it On or Off by going to the View pulldown menu, selecting Toolbars, to it, this indicates the toolbar is presently ON, and no checkmark means it is off.

The toolbar can either float above your map window or be docked. An example of the BRAAT toolbar docked in the application is shown below:

BRAAT Toolbar docked in ArcMap application

The BRAAT toolbar contains nine buttons that are used to insert symbols into your map, print reports, or locate coordinates. The BRAAT toolbar looks like this:

BRAAT Toolbar

Each of the toolbar buttons has a tooltip that displays anytime the mouse hovers over the button. To display the tooltip for each button, position the mouse over each button and l

To display the tooltip for the Crater insertion button:

1. Position the mouse over the left-most button.
2. Let the mouse hover momentarily over the button.
3. The tooltip "Crater" displays.

Four of the toolbar buttons: the Crater, Damage, UXO, and Fire, are functionally similar. The remaining buttons operate differently from these and each other. Therefore, their ope

- Inserting Craters, Damage, UXO's, and Fire Symbols.
- Inserting Casualties.
- Inserting Plumes.
- Inserting MOS.
- Displaying and Printing Casualty Reports.
- Zooming to Coordinate Locations.

Figure 7. Screen Capture of the Geo210 Tutorial

Recommendations for Future Research

In less than one year's time, the ideas of the two automated GIS applications, Build-a-Base and the Contingency Support Exercise have gone from concept to implementation with overwhelming success. However, in an ever-evolving world of IT, complacency is not an option. There is already a great deal of efforts being made to evaluate the applications and determine improvements for future iterations.

One area that is being considered is to increase the scope of the Geo210 Tutorial to include instruction on all the skills expected of cadets throughout their coursework at USAFA in **all** of their core courses. Additionally, there is a new application scheduled for classroom implementation in thefall of 2005, named after

the GeoBase mantra, “One Base . . . One Map.” Under this framework, each cadet on the 4-person cadet team would be in charge of a different operational area of active duty Air Force specialties. These would include a Security Forces Officer, an Operational Support Officer, a Logistics Readiness Officer, and a Civil Engineer. Working off of the same CIP (or map), all four cadets would be required to maintain control and be proponents for their individual areas of responsibility, while still working together with the limited resources that the collocated operating base provides. In this way, each cadet will also feel a greater sense of accomplishment and through greater interaction with the CSE’s scenario. Finally, in order to evaluate the GIS initiatives from the cadets’ perspective, the Academy’s Center of Educational Excellence has supported DFCE through cadet focus groups. These focus groups provide a non-attributional forum where cadets engage in exercises intended to elicit honest feedback. The cadets’ feedback served as a major portion of the “To Do” list for DFCE’s first round of improvements. Therefore, cadets themselves are actually serving to develop and improve the course applications.

While the world’s future may be uncertain, one thing is certain; the future leaders and decision makers of the world's greatest aerospace-force will have a thorough understanding and appreciation of the capabilities that GIS can afford them.

References

[1] "What is GeoBase?" https://www.il.hq.af.mil/geobase/what.cfm (Jan. 2005)

Suermann, Patrick C. (2005) "The United States Air Force Academy: Building our Air Force's Strong GeoBase Foundation." *GIS in the Defense and Intelligence Communities* ESRI Press, Redlands, CA